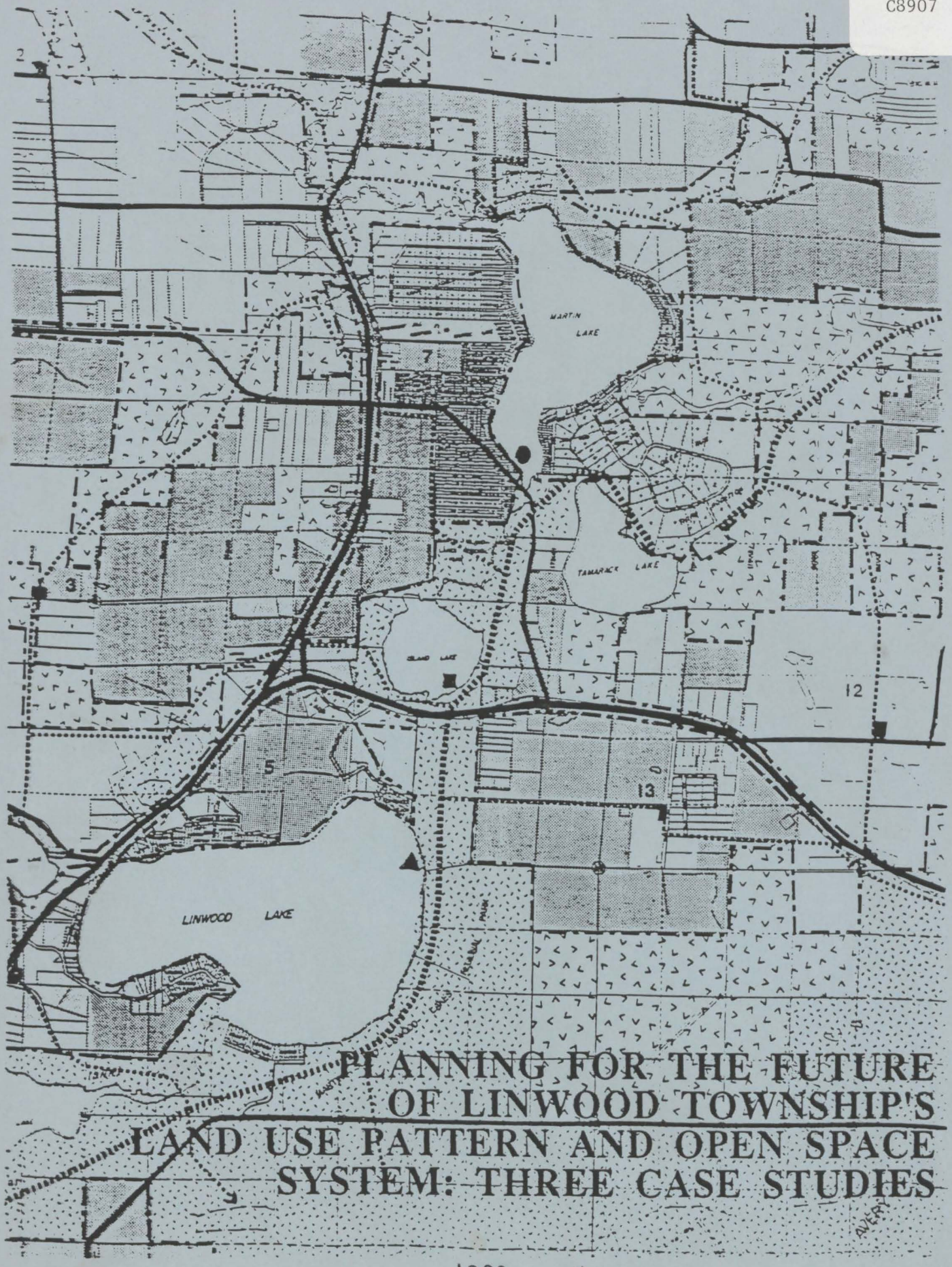

PLANNING FOR THE FUTURE OF LINWOOD TOWNSHIP'S LAND USE PATTERN AND OPEN SPACE SYSTEM: THREE CASE STUDIES

Planning for the Future of Linwood Township's Land Use Pattern and Open Space System: Three Case Studies

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I. INTRODUCTION

Linwood Township Context

Linwood Township is the northeastern most township of Anoka County. The population of Linwood is estimated at 3505 people, and the central business district is approximately 40 miles north of St. Paul Minnesota. Linwood's historic economic base of agriculture is now in transition. Land that was once farm fields is now being platted for residential lots, and the Township is developing into an exurban bedroom community. A large number of Township residents now commute to work in the Twin Cities.

The residents of Linwood have expressed a desire to make the transition from an agricultural landscape to a residential community in a gradual manner, through such measures as requiring potential developers to purchase a minimum of 20 acre parcels and to subdivide these parcels into lots with a minimum size of five acres. The Metropolitan Council's decision not to extend public water and sewer service into Linwood and the lack of high speed vehicular access into Linwood reinforce the Township's desire to promote residential growth and development at a moderate rate.

Township residents have also expressed a desire to retain the rural character of their landscape. This character manifests itself in the diverse pattern of wooded areas interspersed with lakes, open wetlands, and fields. The diverse character of Linwood's landscape provides an abundance of wildlife habitat and natural beauty, and the Township wishes to preserve the values of a diverse wildlife habitat and natural beauty while simultaneously enabling controlled and manageable residential development.

Linwood Township has an extensive complex of waterways including streams, rivers and wetlands. This complex is part of a larger hydrologic system that extends into the surrounding townships. Most of the southern third of Linwood is part of the Minnesota Department of Natural Resources (MnDNR) Carlos Avery Wildlife Management Area, a wetland complex that extends over 18,000 acres. Linwood Township also contains extensive portions of the Anoka County Martin-Island Lake park system. This system includes a chain of numerous lakes, the largest of which are Linwood and Martin, which extends from a southwesterly to a northwesterly direction through the middle of the Township. Other special features of the township are the Minnesota Department of Natural Resources Scientific Reserve adjacent to the Carlos Avery Wildlife Management Area and several other natural areas owned by private organizations. The unifying factor of all these diverse landscape types ranging from agricultural and residential to wildlife preserves is the highly connected wetland complex which is interspersed with hillocks of upland forests.

The Need for Open Space Planning Policy in Linwood

To meet their land use goals of enabling a gradual transition out of agricultural land uses toward limited development of residential land uses, Linwood has adopted a policy of requiring the dedication of open space in the planning and implementation of major residential subdivision development.

The Township is concerned over the quality of open space that it is receiving through the open space dedication program. Subdivision developments implemented to date have apparently resulted in the dedication of land that is unsuitable for development. For the most part this land has also proven unsuitable for many recreational open space uses. Furthermore, there has apparently been little coordination of individual dedications. As a result, the Township's emerging pattern of open space acquisition is hap-hazard. Continuation of existing policies will likely produce an open space system that falls short of its potential for meeting the Township's open space needs.

Realization of Linwood's full open space system capabilities requires a comprehensive investigation of the Township's development goals while at the same time considering its goals for landscape preservation. Simultaneous assessment of the development potential and the open space potential of the Linwood landscape will lead to the creation of an integrated open space system that meets the Township's need for residential growth and development yet preserves the landscape values so important to present and future Township residents.

Participation of Landscape Architecture Students and Faculty

This report summarizes the findings of an investigation of the Linwood Township landscape conducted by students and faculty participating in a University of Minnesota Department of Landscape Architecture (DLA) course during the Fall Quarter of 1989.

Conducted under sponsorship of the Center for Community Studies (an adjunct of the DLA that is funded by the University's Center for Urban and Regional Affairs, the College of Architecture and Landscape Architecture and local communities), the investigation was conducted by Landscape Architecture 5107-Regional Planning and Design, and it examined the development and open space potential of Linwood Township. The class inventoried Linwood's natural resources and analyzed the capacity of the Township's resource base to accommodate an orderly pattern of open space uses within the context of three scenarios of future residential growth and development (maximum development, maximum preservation, and a pattern of both development and preservation).

This report explains the resources analyses and public policy recommendations presented on a series of 10 small scale maps (1 inch = 660 feet) to the Township's Park and Recreation Commission in December of 1989. The reader should refer to this report in conjunction with the graphic presentations contained in the map folio for a full perspective on class activities, findings and recommendations.

II. LAND USE PLANNING FRAMEWORK: THE METROPOLITAN LANDSCAPE PLANNING PROCESS (METLAND)

Linwood Township faces a situation similar to many communities on the outer edges of today's metropolitan areas. Economic, social and political forces existent in a adjacent major metropolitan area together with locally generated forces require the community to examine its changing relationship with the rest of a regional landscape. From a former position of providing agricultural commodities for residents of an adjacent metropolitan area, Linwood Township now finds itself engulfed in a regional landscape where the community has become an outer ring suburb of the Twin Cities Metropolitan Area. In essence, continued economic growth and development has changed the Township's position of being adjacent to a metropolitan area to a position of being part of the metropolitan area. Instead of producing milk that was sent to residents of an adjacent region, the Township now produces housing opportunities for residents of the region.

Yet Township residents, both old and new, choose to live in Linwood partly because of the values manifest in the Township's former relationship of being adjacent to the Twin Cities. New residents come to Linwood seeking more affordable housing opportunities that will enable them to capture the benefits of living in a rural and water-oriented landscape while continuing to work in the Twin Cities. They come to Linwood seeking the opportunity to live in a rural setting characterized by abundant wildlife and a landscape pattern of lakes, wetlands, open fields and wooded areas. The very process of providing housing opportunities to accommodate incoming residents threatens to destroy the landscape values that attract and retain both old and new residents.

Fortunately, the fact that Linwood Township's predicament is part of a national phenomenon of metropolitan expansion means that there already exist several land use planning precedents for guiding the Township's transition. The precedent used by students in LA 5107-Regional Planning and Design is the Metropolitan Landscape Planning Model (known as the METLAND Model) originally developed by Dr. Julius Gy. Fabos, a professor of Landscape Architecture and Regional Planning at the University of Massachusetts.

The METLAND model proposes that metropolitan growth and development need not destroy the landscape values that residents find attractive. Rather, development of areas that were once rural in character can occur in a manner that preserves and enhances significant resource values found in the landscape. The METLAND planning process requires the careful identification and delineation of: **significant natural and cultural resource values in the landscape, natural and cultural conditions that will prove hazardous to future development; and natural and cultural conditions that are intrinsically best suited for land development.** Following this process of landscape inventory and analysis, policies must be formulated to guide future community growth into areas that possess the greatest intrinsic development suitability, where hazards will be avoided, and in a manner that will preserve and enhance the continued existence of significant resource values.

The application of the METLAND model to Linwood Township's implied for the LA 5107 students a need to examine the Township's landscape from three perspectives: **development suitability; natural and cultural hazard; and significant natural and cultural resources** (see Table 1). Development suitability was defined initially in terms of the capacity of the Township's undeveloped soils to accommodate future community development, as defined by the U.S. Department of Agriculture Soil Survey Manual for Anoka County. Because development tends to be guided by the location of existing roads and highways, the definition of development suitability was then modified on the basis of the proximity of undeveloped soils to the Township's road system.

Hazards to development were assessed principally in terms of the location of the Township's undeveloped land area relative to the 100 year floodplain.

Significant resource values were assessed as they relate to: preserving the Township's wetlands; maintaining the visual character of Linwood Township's rural landscape pattern; preserving and enhancing the ecological structure and diversity of diversity of plant and animal species and habitat connections in the Township's landscape; and preventing pollution of the Township's surface and ground water resources by land development activities.

Table 1. Application of Metropolitan Landscape Planning Model (METLAND) to Linwood Township Landscape

METLAND Model Element	Operational Definition for Application to Linwood Landscape
A. Development Suitability	1. Suitability of undeveloped soils for community development. 2. Proximity of undeveloped soils to existing road system.
B. Natural and Cultural Hazards	1. Location of 100 year floodplain.
C. Significant Natural and Cultural Resources	1. Wetland soils. 2. Visual character of Linwood's rural landscape pattern. 3. Plant and animal species diversity. 4. Plant and animal habitat connectivity. 5. Surface and ground water quality.

III. APPLICATION OF METLAND PLANNING FRAMEWORK TO THE LINWOOD TOWNSHIP LANDSCAPE

Landscape Resource Inventory

In using the METLAND model to develop the land use planning policy recommendations contained in this report, the student in LA 5107-Regional Planning and Design began their planning process with a basic inventory of the Linwood Township landscape. The inventory included examining surface and bedrock geologic conditions of Linwood based on information mapped by the Minnesota Geological Survey. The Township's soils as described in the Anoka County Soil Survey Manual were mapped. Slopes were inventoried from U.S. Geological Survey 7-1/2 minute quadrangle maps applicable to the Township. Hydrologic systems, both surface and sub-surface, were examined through examination of the U.S.G.S. maps and data from the Minnesota Geological Survey. Landcover conditions (i.e. land use and vegetative cover), were interpreted from 1986 half-section aerial photographs of the Township provided by the Anoka County Surveyor's Office and aerial photographic slides obtained from the U.S. Department of Agriculture - Agricultural Stabilization and Conservation Service. Land parcel boundary information was obtained from the Anoka County Surveyor's Office. Parcel boundaries depicted on the Surveyor's base map of Linwood Township were updated by comparing the Surveyor Office data with the 1988 Anoka County Plat Book. Finally, members of the class developed a question for inclusion in a survey of Township residents conducted by Linwood Park and Recreation Commission. The question asked survey respondents to identify the three areas of the Township that they find most attractive.

All of these data were initially mapped at a scale of 1 inch equals 660 feet. The Linwood Township Landcover Inventory Map (**Map 1** in the map folio) illustrates the results of the inventory process for landcover. **Map 2** depicts the boundaries of parcels in Linwood Township that exceed 40 acres, 80 acres and 160 acres in size, respectively.

Assessment of Development Suitability

Existing Development Pattern. As a first step in assessing development suitability of the Linwood Township landscape, the landcover map of the Township (see **Map 1** in folio) was examined to ascertain the location of those portions of the Township that are currently in some form of development (residential, commercial, etc.) or are in some form of dedicated open space use (e.g. town and county park systems, the DNR Scientific Reserve, the Carlos Avery Wildlife Management Area). Both the existing development pattern and the dedicated open space areas were considered pre-emptive land uses. Development was defined as including all existing industrial, commercial and residential uses on parcels smaller than 20 acres as well as platted subdivisions on parcels of less than 20 acres. These parcels were eliminated from all subsequent analyses, and their location is illustrated on **Map 3** of the map folio.

Soil Suitability for Community Development. The U.S.D.A. - Soil Conservation Service has defined in the Anoka County Soil Survey Manual eight community development soil groups. Soils are classified into a group based on their natural soil drainage, slope, texture, permeability, and depth to water table or bedrock. The soil groups are then assessed in terms of the constraints they pose for future community development. This assessment is evaluated in three categories:

Slight- indicates little or no limitations for community development with very few soil modifications being needed for development.

Moderate- indicates presence of unfavorable soil limitations (e.g. moderate slopes, slow percolation rates, etc.) which may be ameliorated by planning and design.

Severe- indicates presence of very unfavorable soil conditions (e.g. flooding, shallow water table, severe slopes) which render the soil unsuitable for community development.

Map 4 presents the location of soils possessing slight, moderate or severe limitations for future community development in Linwood Township. On this map, pink indicates slight limitations, grey indicates moderate limitations; and white signifies severe limitation.

Proximity to Existing Road System. The location of future development is often dependent upon the proximity of developable soils to existing road systems. The existing roads provide access from one neighborhood to another, and they provide access to major arterial highways leading to the Twin Cities. In an attempt to assess the effect of the existing road system on the attractiveness of undeveloped land for future residential land uses, data were obtained from the Anoka County Highway Department that describe various characteristics of Linwood's road system. These data include the functional classification of the roads in the existing system and the traffic volume of the roads. Functional classification describes the Township's existing roads as being residential access streets, residential sub-collector roads, residential collector roads, or major collector highways and it is based on the Average Daily Traffic (ADT) of the road. Residential access streets are characterized as having an Average Daily Traffic (ADT) flow of between 200 and 500 vehicles per day. Residential collector roads experience an ADT of 500-999, while residential collectors have an ADT of 1000-2999. The ADT of collectors exceeds 3000.

The attractiveness of a land parcel depends on its proximity to various components of the road system. An undeveloped parcel located closer to a high volume collector highway is presumed to be more attractive for future development than is an undeveloped parcel located further away from all roads with access available only from a gravel road. In assessing proximity to the road system, three classes of distances were established: within a quarter mile of a road; between a quarter and a half mile of a road; and greater than a half mile from a road. Table 2 presents a road attractiveness classification system that combines traffic volume counts, functional classification and proximity into a numerical scale. This scale ranges from

100 points (indicating land located with in a quarter mile of a 3000 ADT road) to 30 (greater than a half mile from a residential access road). **Map 5** in the folio illustrates the attractiveness of land in Linwood Township for community development based on this road classification system.

Table 2. Development attractiveness points assigned to Linwood landscape based on proximity to different types of roads.

Road Characteristics		Distance from Road		
Road Type	Average Daily Traffic Flow	Within 1/4 mile	1/4 to 1/2 mile	Greater than 1/2 mile
Residential access	200-499	70	50	30
Residential Sub collector	500-999	80	60	40
Residential collector	1000-2999	90	70	50
Collector	≥3000	100	80	60

Assessment of Hazards

The assessment of hazards in Linwood Township focused on a delineation of the 100-year floodplain. Maps prepared under auspices of the National Flood Insurance Program identify the 100-year floodplain for Anoka County. That portion pertaining to Linwood Township was enlarged to a scale of 1 inch equals 660 feet, and it is presented in **Map 6** of the map folio.

Analysis of Significant Resources

Wetlands. The Anoka County Soil Survey Manual identifies the frequency with which Linwood Township's soils are flooded. Those Linwood soils that are occasionally or frequently flooded were designated wetlands soils. The location of these wetland soils in the Township was mapped at a scale of one inch equals 660 feet. This map correlates very strongly with the map of those areas classified by the MnDNR as protected waters and wetlands as depicted in **Map 6** of the map folio.

Visual Character of Linwood Landscape. The visual character of the Linwood Township landscape is strongly related to the pattern of open spaces contrasted with closed areas that are visually impenetrable. The Township's visual character is produced by the flow of open spaces that meander around the visually impenetrable solid masses. The proximity of this pattern to the Township's road system refines the definition of the Linwood landscape's visual character as it is the view from the road that is the most characteristic manner in which the landscape is experienced by residents and visitors.

The elements of the Township's visual character can be defined and mapped from the landcover map presented in **Map 1** and the Township's road system presented in **Map 5**. Open areas in the landscape are most frequently created by agricultural fields and pastures, wetlands and lakes. Closed visually impenetrable areas relate primarily to the pattern of deciduous and coniferous woodlands, hedgerous and windbreaks at the perimeter of agricultural fields and shelter belts planted around farmsteads. The Township's road system defines the location of views from which the mottled

pattern of open and closed areas is experienced.

In translating these elements into mappable dimensions, the students in LA 5107-Regional Landscape Planning and Design felt the most important elements to consider were the Township's road system, the wetland patterns and the existence of viable farms. The class presumed that wetlands would not be developed, and the wetland to upland pattern is more fully evaluated in assessing the ecological structure and diversity of the Linwood landscape. Therefore, assessment of visual character focused on delineating and evaluating farmland that was visually accessible from the Township's road system.

Farmland in Linwood was inventoried by examining the landcover map (**Map 1** in the folio) and the parcel boundary data obtained from the Anoka County Surveyor's Office and the 1988 Anoka County Plat Book. Farmland was identified as including those farmsteads and agricultural fields that included contiguous ownership of 40 or more acres. The quality of this farmland was evaluated by overlaying soils data on a map illustrating identified farmland acreage. Soils were aggregated into three farmland quality classes based on the agricultural capability class to which the soil belonged as identified in Anoka County Soil Survey Manual. The three quality classes and their constituent agricultural capability classes are defined in Table 3. Individual farm units were assigned a composite farmland quality rating by multiplying the percent of the farm unit's soils that were in each farmland quality rating indices by its respective index and summing across all soil types found on the farm.

A map illustrating proximity of farmland to the county road system was overlayed on a map showing composite farmland quality ratings for each farm. Proximity to roads was defined by three classes: within a quarter mile of a road; between a quarter mile and a half mile of a road; and greater than a half mile of a road. These road proximity classes were assigned values of 4, 2 and 1, respectively. An overall farm unit visual character importance rating was subsequently derived by multiplying the composite farmland quality index derived from the soil capability analysis by the road proximity value. These overall ratings were aggregated into three classes (high, medium and low). **Map 7** in the map folio shows the locations of these three classes of overall farmland visual character ratings.

Table 3. Definition of farmland quality rating index.

Rating Index	Quality of Farmland	Constituent Agricultural Cability Classes
3	High	I, IIw1, IIw2, IIw3, IIe1, IIe2
2	Medium	IIIw3, IVw1, IVw2, IVw3, IVe1, IVe2
1	Low	All remaining classes

Assessment of Plant and Animal Species Diversity. One of the outstanding features of Linwood Township is the variety of wetlands and uplands which support a vast array of plant and animal wildlife. While the DNR manages large acreages in the Carlos Avery Wildlife Management Area, the rest of the Township lands play a role in maintaining the overall abundance of plant and animal life.

The class analyzed the Linwood landscape from a perspective of maintaining plant and animal species abundance and diversity as a major objective. The species diversity model is based on concepts put forth by Richard Foreman and Michel Godron, two landscape ecologists who have written a text entitled Landscape Ecology. Landscape ecology is the study of the landscape structure and function that goes beyond the study of a specific plant or animal community.

One of the key concepts in landscape ecology is that a healthy environment is a stable environment. Stability in the natural world is dependent on systems of complex interactions between a wide range of species. With more diversity, a natural system can recover easier from small changes to the environment. For instance, a bird with several alternative nesting sites and food sources has a better change of survival than a bird dependent on one plant species that could be damaged by drought or storms.

According to landscape ecology principles, the highest degree of species diversity occurs at the edge of two types of landcover. The more edge, the more abundant this diverse mix of species. More diversity also occurs where there are different types of landcover near each other, since different species are attracted to different cover or combinations of cover. For instance, an area with a lake in the midst of farm fields, open meadow and a conifer stand would likely harbor a large diversity of species, both plant and animal.

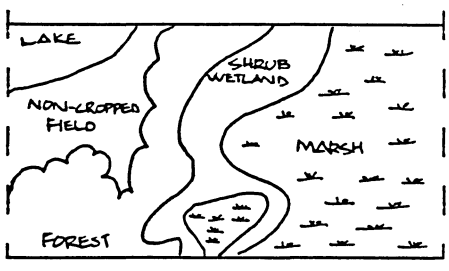
Along with the importance of diverse environments, the landscape as a whole should be diverse. Some species require large stretches of uninterrupted landcover as a habitat. Provision for these species creates an overall diversity.

The class inventoried existing species diversity based on these principles. Using a 40 acre grid placed over the whole Township, each cell in the grid was evaluated for three landcover characteristics. These characteristics were: number of landcover types (known as "patches"), the total number of patches, and the relative length of edge between each patch. Added together these numbers provide a composite diversity index. The higher this index, the higher the diversity. The following examples illustrate application of these concepts.

Land Cover Types in Linwood

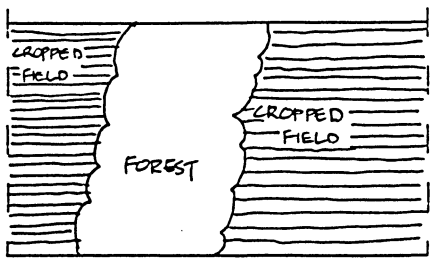
Residential
Streams and lakes
Wetlands
  -cattail marsh
  -shrub
  -wooded
Wooded
  -deciduous
  -coniferous
Fields
  -cropped
  -non-cropped

| Higher Diversity |



5 patch types
6 patches
4 edge length
15 = diversity index

| Lower Diversity |



2 patch types
3 patches
2 edge length
7 = diversity index #

The species diversity indices for all of the 40 acre cells numbers ranged from 2 to 30. A low score indicates a cell with few patch types, few patches and little edge-- a homogenous environment. On the other hand a high scoring cell represents the opposite effect-- an array of patch types with lengthy edges. This cell has the potential for a high diversity of species.

After analyzing these data, the class decided to call out areas at the top and bottom of the scale. These extremely diverse or extremely homogeneous areas would need consideration in any development alternative. Values from 2-6 fell into the lowest 10% out of the total and values from 19-30 constituted the top 10% out of all the cells. Table 4 presents a summary of how many cells were characterized by the range of species diversity indices from 2 to 30. Map 8 in the map folio illustrates the spatial distribution of these species diversity indices.

Table 4. Frequency distribution of 40 acre cells by Species Diversity Index

Diversity Index	Number of Cells with that Index
2	12
3	0
4	9
5	20
6	8
7	32
8	36
9	36
10	56
11	54
12	56
13	50
14	42
15	37
16	32
17	24
18	19
19	11
20	13
21	7
22	7
23	6
24	2
25	2
26	1
27	2
28	0
29	0
30	1

Habitat Connectivity Assessment. Another ecological index of landscape stability is the concept of connectivity. This term relates to the movement of species, an important factor in the continued survival of a healthy population. For purposes of this LA 5107, the major concern was with the upland species, since future development will occur here rather than in the wetlands. For instance, a wooded patch surrounded on all sides by wetlands has the ecological characteristics of an island. Without an upland connection to other woods, the species diversity would be limited--emigration or immigration of many species could not occur.

Measuring connectivity is not an exact science. After analyzing the upland complex, the class identified connections as narrow pieces of upland between two upland patches. As a rule of thumb, a narrow was less than 660' wide. In the same way that a house located in the middle of a freeway would obstruct traffic, future development in these connectors would obstruct movement of some species.

Within the context of Linwood, some connectors are more important than others. After identifying the upland narrows the Township (excluding those in the Carlos Avery Wildlife Management Area), values were assigned to each connection type as follows:

3 = connectors of critical importance because they are the only bridge between two large, relatively undeveloped upland patches.

2 = connectors of moderate importance because they link two smaller uplands (approx. 40-150 acres), lead to a "dead end" or provide one of several alternate routes.

1 = connectors of slight importance because they connected areas already highly developed or were roads through wetlands and of value to only a limited number of species.

Identifying these connectors is especially important because they coincide with areas likely to be developed. Once developed they are lost permanently as a resource which is essential to maintaining the health and diversity of the natural (and human) environment. **Map 9** illustrates the location of the three types of habitat connections.

Protecting Surface and Ground Water Quality. The quality of surface and ground water resources is affected by various land use activities. Industrial manufacturing process often generate waste byproducts that are discharged into surface water bodies. These by products often contain heavy metals (e.g. lead, zinc, cadmium, mercury) or hydrocarbons which can be toxic to aquatic plant and animal species. Depending upon the level of treatment provided by a sewage treatment plant, the discharge from treatment plants can also contain heavy metals, and it often contains high concentrations of nitrogen and phosphorous. Runoff from urban streets and parking lots, residential areas and agricultural fields also often contain high concentrations of heavy metals and pesticides that are toxic to aquatic life. Urban and agricultural runoff sometimes contain excessive soil sediments that destroy aquatic habitat, and it often contains high levels of nitrogen and phosphorous.

Nitrogen and phosphorous are essential nutrients for plant growth and development. However, when nitrogen and phosphorous are abundantly present in an aquatic ecosystem, they can stimulate excessive growth of microscopic plant organisms known as phytoplankton. Growth of phytoplankton communities can block penetration of sun to rooted aquatic plants that are submerged below the water surface. The shading of these rooted aquatic plants by phytoplankton results in the eventual decline of aquatic plants other than plankton. Eventually, this disrupts communities of animal species dependent on these plants for food, cover or breeding sites. As the phytoplankton die, their decomposition consumes oxygen levels in the water body. The reduction of oxygen levels in the water deprives animal communities of oxygen resulting in their suffocation. The destruction of plant and animal species through over-enrichment of nitrogen and phosphorous is known as eutrophication. Eventually, eutrophication can result in the decline of the entire aquatic ecosystem contained in a surface water body.

The Linwood landcover map (see **Map 1** in the map folio) reveals that the Township has no sewage treatment plant, and there are few industrial land uses in the Township. Therefore, the major threat to the quality of the Township's surface and ground water resources comes not from point-sources such as treatment plants and industrial plants. The most significant threat to water quality in Linwood comes from non-point sources associated with urban, residential and agricultural runoff and from ground water flows from on-site septic tank sewage disposal systems into surface water bodies.

In focusing on the management of non-point sources of water pollution in Linwood, the class made careful studies of the Township's hydrological systems. These studies examined the location and character of streams, lakes and wetlands in the Township. They examined the flow of surface and ground water from urban, residential, and agricultural land uses into surface water bodies. Estimates were made of the probability that non-point source surface runoff from these land uses or ground water flows from on-site septic tank sewage disposal systems would contribute excessive sediment and nutrient loads to surface water bodies. Filter strips planted close to surface water body or wetlands adjacent to a lake can intercept and retain large amounts of nutrients and sediment. Therefore, the hydrologic studies also examined the buffering potential of these landcover elements in reducing the delivery sediment of nutrient loads to surface water bodies.

The hydrologic studies conducted by the class divided Linwood Township into 40 acre grid cells (identical to those grid cells used by the examinations of species diversity and habitat connections). This grid was overlayed on the landcover, topographic and the soils maps. Cells were rated on their potential for delivering sediment and nutrient loads to adjacent water bodies. The ratings represented a composite assessment of the cell in terms of soil infiltration capacity, existing landcover, slope, position in the landscape drainage pattern, distance to surface water, and buffering landcover elements between the cell and the nearest downslope water body. Cells characterized by soils with low infiltration capacity, residential or agricultural field landcover, steep slopes, close proximity to water bodies and no intervening landcover that could buffer sediment or nutrient delivery were presumed to have higher potential for contributing to water quality

degradation than their high infiltration capacity, forested, more gently sloping and more remotely located (with respect to water bodies) counterparts. The range of composite water quality degradation ratings among all of the Township's cells were grouped into three categories. Map 10 illustrates the location of those cells found to have high, moderate and low potential for water quality degradation.

IV. PLANNING RECOMMENDATIONS FOR FUTURE RESIDENTIAL DEVELOPMENT AND OPEN SPACE SYSTEM

Having completed the landscape resource analysis described in Section III of this report, the class divided into three design teams. Each team used the analyses to prepare planning recommendations for guiding future residential development in Linwood. The analyses also provided a basis for recommending the open space pattern that will be needed to support each development pattern. Each team assumed a different set of objectives relative to the balance of landscape development and landscape preservation in the future land use pattern in Linwood Township.

Recommendation of Design Team I: Assuming Maximum Development of the Linwood Landscape

The objectives adopted by Team I focused on maximum development of the Linwood landscape. This group's plan attempts to develop Linwood Township to its capacity with regards to development suitability, protection from hazards, and preservation of significant resources. The following discussion outlines the analysis, plan and policy produced by the group.

Analysis

The analyses conducted by the class were divided into three categories, 1) development suitability, 2) significant resources, and 3) hazards. The following discussion describes the maximum development group's response to each of these analyses.

Development Suitability: Land Pre-empted by the Existing Development Pattern. The Linwood landcover map (**Map 1**) and the Preemptive Land Use and Existing Development map (**Map 3**) identify areas which have already have been developed or platted, existing parks, and the Carlos Avery Wildlife Management Area. These areas were treated as givers and attempts were made to integrate these areas into future planning.

Development Suitability: Community Development Soils. The community development soils map (**Map 4**) identifies areas of Linwood that are suitable for development based on soil characteristics (factors included septic and building suitability). The maximum development group considered an area suitable for development if it required slight or moderate modifications. If an area had soils which could not support development at the 2 1/2 acre density, but could support lower densities, it was indicated as an area of special development concern. This factor was the primary determinant for development suitability. A map showing the Team I analysis of development suitability is presented in **Map 11.**

Development Suitability: Proximity to Existing Road System. Road proximity was not considered in the analysis because this team's intent was to maximum development so all suitable areas will eventually be developed. The A.D.T. data were used, however, in determining the edges of the future neighborhoods within the Township.

Significant Resources: Visual Character. The residents of Linwood Township have indicated that they value the rural character of the area. This includes the farms within the Township. However, most of the land that is good for farming is also good for development. In addition, the size of the farms and their productivity are insignificant when compared to other farming regions in the state. Based on this information, as well as the objectives assumed by this team (maximum development), it was assumed to be not feasible to maintain farming practices in Linwood. Thus, the visual character relating to preserving existing farms did not enter into this team's decision making.

Significant Resources: Species Diversity. The species diversity model indicated prominent areas of homogeneity and heterogeneity. Team I highlighted these areas within the Township and labeled them as areas of special species concerns. This means that they are suitable for development but special precautions should be taken in order to preserve plant and animal species diversity. In addition to the species diversity analysis prepared by the class, the landcover map was consulted to find contiguous patched of woodland greater than 50 acres. The species model was inadequate for this because the 40 acre cell used did not recognize these patches due to their shape.

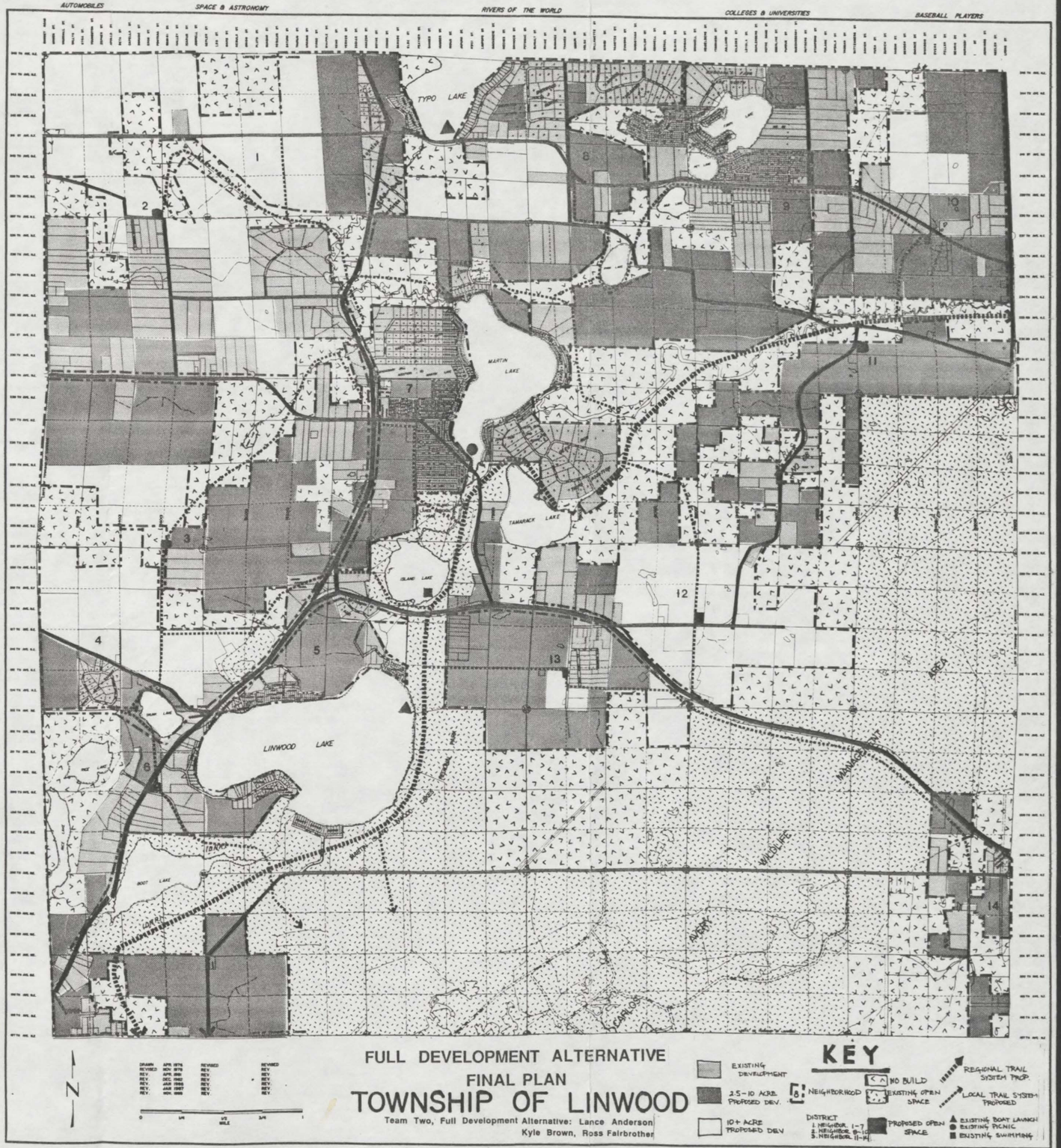
Significant Resources: Habitat Connectivity. The habitat connectivity map indicated important upland connections for species flow across the Township. The most important connections (i.e. those having a value of 3 on Map 9) were used in the analysis by the maximum development group. These areas, like the homogeneous and heterogeneous areas, are important to preserve. This is because plant and wildlife habitat is important to the rural character of Linwood. It is one of the attractions that draws people to Linwood and it can be an asset to development areas. These were labeled as environmental caution areas which could be developed with sensitivity.

Hazard Assessment: 100 Year Floodplain. Flooding is the primary landscape hazard in Linwood. Anoka County allows development within the 100-year floodplain as long as the development is specially constructed to accommodate flooding. Therefore, the 100-year floodplain was not considered in determining where to develop. However, it does guide suggested policies regarding development.

Plan

The overall plan developed by Team I for the Township addresses two issues: 1) future residential development and 2) comprehensive park and open space system. Figure 1 presents the residential development and open space land use plan devised by Team 1. The plan devised by this team is also presented as **Map 12** in the map folio.

Future Residential Development. The primary factor that drives the future residential plan is the community development soil suitability analysis. The areas already developed are integrated into the overall plan. Areas suitable for higher density development, based on soil characteristics, species diversity, and habitat connectivity are zoned for 2 1/2 acre parcels. The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ISLAND LAKE
LINWOOD LAKE
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FULL DEVELOPMENT ALTERNATIVE
FINAL PLAN
TOWNSHIP OF LINWOOD
Team Two, Full Development Alternative: Lance Anderson
Kyle Brown, Ross Fairbrother
KEY
EXISTING DEVELOPMENT
2.5-10 ACRE PROPOSED DEV.
10+ ACRE PROPOSED DEV.
NEIGHBORHOOD
NO BUILD
EXISTING OPEN SPACE
PROPOSED OPEN SPACE
REGIONAL TRAIL SYSTEM PROP.
LOCAL TRAIL SYSTEM PROPOSED
EXISTING BOAT LAUNCH
EXISTING PICNIC
EXISTING SWIMMING

FIGURE 1.

areas suitable for lower density housing, based on the same criteria, are zoned for 10+ acre lots. These are standards currently used by the Township. Figure 2 illustrates the decision-making logic used to determine future development densities in Linwood Township.

The developable areas (and the areas currently developed) are divided into three districts and fourteen neighborhoods. The edges of these districts and neighborhoods are determined by prominent natural and cultural features (e.g. lakes, streams, roads, parcel boundaries of publicly owned land). Each of these neighborhoods has it own identity, and neighborhoods relate to one another within their respective district. One way these relationships are expressed is in the Linwood park and open space system.

Park and Open Space System. The park and open space system is a comprehensive plan which links the entire Township together and gives it identity. The hierarchy of the park system is connected and related through the utilization of Linwood's open spaces as a trail system. The neighborhood parks provide each neighborhood with an identity as well as a small scale recreational amenity (play equipment, small field, etc.). The location of these parks is based on centrality and landcover suitability for park needs. The district parks relate to many neighborhoods due to location and connecting paths (ball fields, hockey rinks, etc.). The regional park in the center of the Township relates to all the districts again through location and trails. This plan also proposes an inter-township trail system to be maintained at a regional scale.

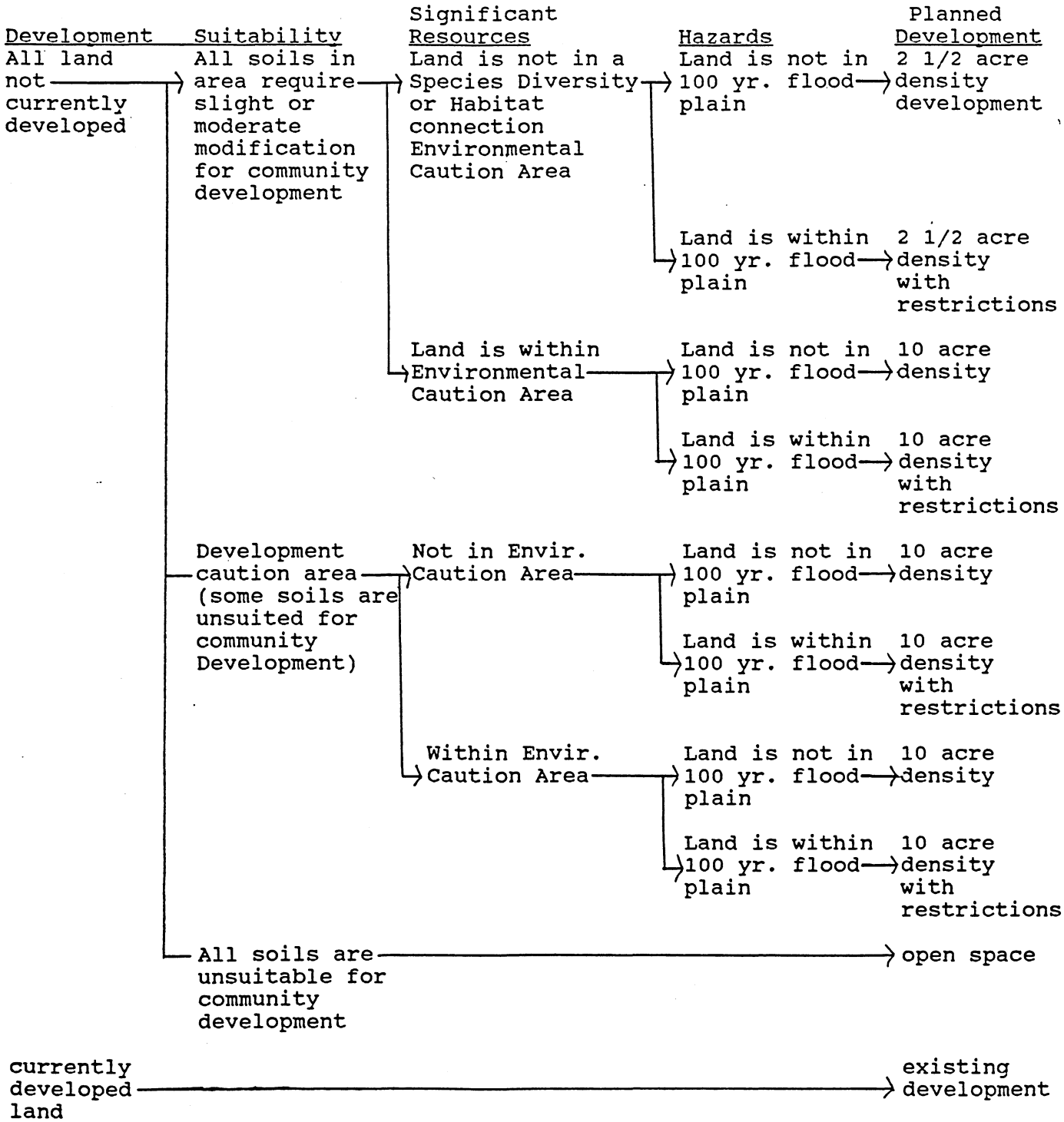
The scenario of maximum development suggests that development is top priority. Therefore, while the parks centralize themselves in the development areas, the open space system exists primarily in areas unsuitable for development (except to provide necessary connections). These areas often follow prominent geographic features such as rivers or lakes and allow for interesting linkages into the neighborhoods. An attempt was also made to include major species connectivity areas in the open space system where feasible.

Planning Policy

The following planning policies are recommended to guide the management of land use in Linwood Township. The drawings in the Map Folio immediately following **Map 12** illustrate application of several of the policy recommendations to the Linwood Township landscape.

Wetlands Protection. Linwood Township should protect all wetlands. No wetlands within the Township boundaries should be filled or altered in any form, regardless of size. This aids in preserving rural character as well as in preserving the wetland matrix.

Figure 2. Decision-making logic used to determine future development densities



Nutrient Filter Strip. Linwood Township should enforce the implementation of a 50 foot filter strip around all wetlands and open waters larger than 10 acres (in accordance with Minnesota Department of Natural Resources (DNR) definitions of lakes and wetlands). This filter strip extends 50 feet from the indicated high water mark of any water body. The strip should consist of Township approved herbaceous and woody plant materials and it should require additional approval of management practices within the filter strip. These practices should be sympathetic to the impedance of sediment and nutrient flow through the filter strip. This is necessary to mitigate the impact of surface land development on nutrient flow.

Lot Sizes. The minimum lot size in Linwood should be 2 1/2 acres. Lower density zoning exists in specially designated areas.

Setbacks. The minimum front yard setback should be 65 feet from the front property line. The rear yard setback should be 60% of the total lot length. This requirement is needed to maximize open space and interior habitat for species, particularly in environmental caution areas.

Indigenous Vegetation Removal. A minimum of 25% of the distance from the rear property line must be maintained with indigenous vegetation. This vegetation must remain in its pre-development character, or evolve in natural ecological process (i.e. diversity and connectivity, old field succession). This policy will maximize species habitat diversity and connectivity, particularly in environmental caution areas.

Floodplain. Development within the 100-year floodplain is permitted in Linwood, but it must meet the following specific guidelines:

1. The finished floor elevation of the building must be at or above the designated flood protection elevation.
2. Development within the floodplain will not result in a cumulative increase in floodplain elevation that exceeds six inches.
3. Access roads to development must be at an elevation not higher than designated flood protection elevation.

Roadside Swales. Roadside swales shall not be mowed in order to retain the rural character of the Township. This also provides habitat for species movement.

Open Space Dedication Policy. Developers must make a donation to aid in the establishment of the Township's park and open space system. The amount of this donation will constitute 5% of the total value of the development. Any land within the development which is designated as part of the park and open space system must be dedicated to the Township. Land dedication can substitute the donation of money in certain situations. This will add cohesiveness to the park system and provide a financial base as well.

Cluster Development. While 2 1/2 acre lots are a minimum size in Linwood, for conventional development, use of this density in all areas suited for 2 1/2 acre density would eliminate much of rural character of the Township. Therefore it is suggested that the Township consider other zoning options,

such as clustering houses on smaller lots, with more extensive open space between clusters. Proposals like these can aide in retaining rural character as well as species habitat diversity and connections.

Recommendations of Design Team II: Assuming a Balance Between Landscape Development and Landscape Preservation

The objectives adopted by Team II focused on creating a land use pattern that seeks a balance between developing Linwood Township to its capacity and preserving the status quo. The Team II planning recommendations were developed by combining the findings of the development suitability analysis with the hazard assessment data. The results of this combined analysis of development suitability and hazard assessment were then correlated with the significant resource data to form the basis of the team's planning recommendations.

In determining land suitable for future development, Team II compared the existing landcover analysis **(Map 1)** with the community development soil suitability analysis **(Map 4)** and the 100-year floodplain data (Map 6). Land that was not currently in residential or commercial land use, not platted for future residential or commercial uses, or not in some form of public ownership (e.g. county or township park, DNR land, etc.) was considered suitable for future development if:

1) all soils on the parcel had slight limitations for community development; or
2) Soils had moderate limitations for community development and the parcel was not located in the 100-year floodplain.

All soils rated as having severe limitations for community development and all soils having moderate limitations for community development that are within the 100-year floodplain were considered to be unsuited for residential development. However, these soil types do not necessarily exclude the possibility of use for recreational development, particularly for trails. Many of these developable land areas could be used for extensive recreation to link existing and proposed residential development to parks, open spaces and water bodies. A map showing areas suitable for development according to Team II's analysis is presented in **Map 13.**

Having identified developable portions of the Linwood landscape, Team II then examined the relationship of these land areas to significant resource values in the Township. Definition of land areas containing significant resource values included:

1) Those areas containing the top 15% of the 40 acre grid cells most likely to generate excessive nutrient flows;
2) Those areas containing the top 10% as well as the bottom 10% of the 40 acres grid cells likely to contain highest species diversity. This analysis includes both the most diverse and the most homogeneous of the grid cells.
3) Those areas considered to be significant connectors of upland habitat.

4) Those farm areas that are both the most productive and the most visible from the Township's road system.

Those portions of the Township's developable land area that are characterized as possessing any of these four characteristics (see **Map 14**) should be designated as Environmental Protection Zones. Those portions of the developable land are that are outside an Environmental Protection Zone could be developed at a 2 1/2 acre density. Land falling within an Environmental Protection Zone, however, would be developed at a lower density. Development within an Environmental Protection Zone would have to demonstrate, through a site plan review process, the ability of the proposed development to meet specified performance standards related to maintaining Linwood Township's rural character and species diversity and related to minimizing nutrient flows. Figure 3 and **Map 15** present maps illustrating the land use and open space plan proposed by Team II.

Recommendations of Design Team III: the Preservation Alternative

Goal Definition

In designing an open space system with a preservation orientation, Team III first developed goals to define the meaning of preservation. Three preservation goals emerged, as follows:

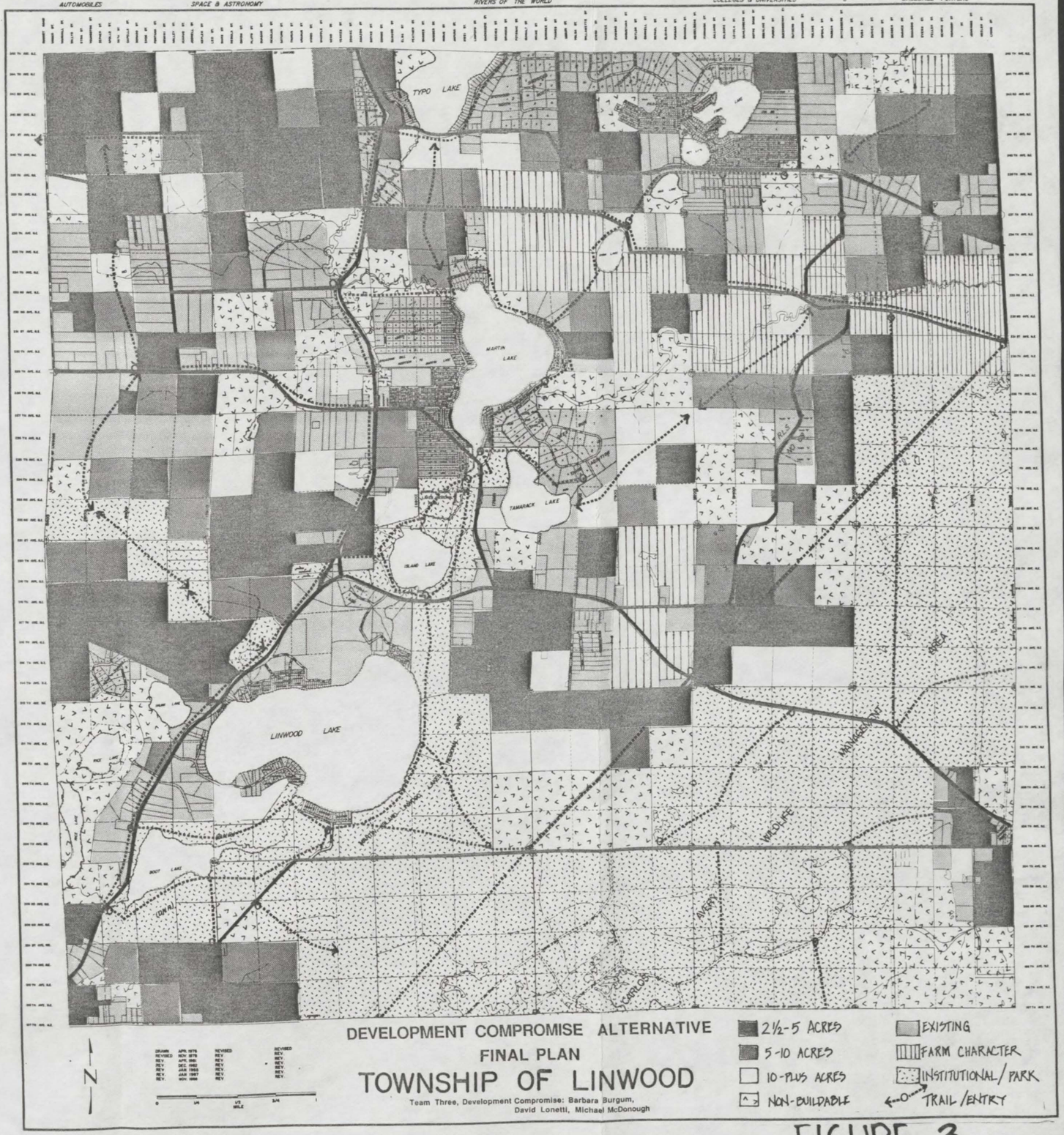
1) Preserve the existing settlement pattern of development dispersed through the Township in loose clusters between large open areas and park lands. Open areas are defined as unplatted lands, and they include farmlands.
2) Preserve plant and animal species abundance and diversity.
3) Preserve water quality.

All of these goals together represent an overall perspective of encouraging development where there will be a minimal impact on existing human and wildlife habitat. Efforts to find these areas will not only reveal where future dedicated open spaces should be located, but they also preserve the environment which people have moved to Linwood to enjoy.

Means to Achieve Goals

Practically speaking, these preservation goals appear, on the surface, to conflict with the Township's need for revenue to sustain an intensive use (ball fields, hockey rinks) and extensive use (trails) park system which meets preservation goals. The preservation alternative must therefore not require large amounts of capital which would have to be generated through property taxes.

For these reasons, Team III chose to develop a land use plan that designates different residential density zones. The determination of these zones is outlined in the following discussions. Once these zones were determined, Team III then delineated areas which are most suitable for dedicated park land in high density residential areas.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BOOT LAKE
WILDLIFE
AVERY
CARLSON
DEVELOPMENT COMPROMISE ALTERNATIVE
FINAL PLAN
TOWNSHIP OF LINWOOD
Team Three, Development Compromise: Barbara Burgum, David Lonetti, Michael McDonough
2½-5 ACRES
5-10 ACRES
10-PLUS ACRES
NON-BUILDABLE
EXISTING
FARM CHARACTER
INSTITUTIONAL/PARK
TRAIL/ENTRY

FIGURE 3.

Outcomes

A zoning system is proposed that is based on preservation and development suitability values. The low density zone will be used to preserve areas of importance to the Township's existing character, habitat structure and water quality. Park, and open space are provided where they will be most accessible and needed.

Team III also considered the loss of development potential on some land that is physically capable of supporting development, but valuable in an undeveloped condition. For these areas, Team III proposes creating an opportunity for owners to sell development rights to those with property which can accept more than the base density levels without impact on existing wildlife and human habitat.

To address preservation issues not answered by zoning decisions, Team III proposes adoption of a development standards approach. Such standards might include water quality ordinances as well as provisions for other land management practices which will protect the environment.

Finally, Team III suggests a system of trails which link the Township parks and allow residents to enjoy the environment which has been preserved through implementation of its plan. These trails would be established through easements, either granted or purchased.

Planning Strategy

Determining Development Suitabilities Based on Soil Suitabilities and Natural Hazards. As a first step, Team III delineated land areas not suitable for any development. These areas include:

1) land already platted.
2) wetlands.
3) state and county park or reserve lands.

Having defined land areas pre-empted from future development by existing land use, Team III then delineated areas suitable for limited development (i.e. some structures, no septic). Limited development areas include:

1) land with moderate and severe community development limitations based on SCS classifications examined in the community development analysis map.
2) land within the 100-year floodplain.

The land areas in Linwood Township that were not identified by the pre-empted land use analysis or identified as limited development areas were designated as suitable for residential development with on-site septic tank systems. Further analyses of areas suitable for residential development were conducted using a forty acre grid. The analyses were performed for each cell on this grid. A map of development suitability, based on the Team III analysis, is presented in **Map 16.**

Determining Base Density Levels for Each 40 Acres Grid Cell. Three density levels were designated as follows:

High = 2-1/2 to 5 acre lots (the existing maximum subdivision parcel).
Medium = above 5 acres to below 20 acre lots (hobby farm size).
Low = 20 acre lots and above.

These density classes were assigned to the 40 acre grid cells possessing land suitable for residential development on the basis of the percentage of a grid cell that was classified as suitable. Forty acre cells containing fewer than five acres of developable land were assigned a low density status. Cells containing between 5 and 15 acres of developable land were assigned a medium density status. High density status was assigned to all cells containing 15 or more acres of developable land.

Determining Factors that Would Alter Base Density Levels. Having defined base density levels for each 40 acre grid cell in Linwood Township, Team III then examined the Township's visual character, plant and animal habitat and water quality that serve as the targets of the preservation effort. Nutrient flows and significant resources already analyzed by the class were incorporated into a system which raised or lowered the base line density.

The nutrient flow model was used to identify areas that would be most appropriate for development or least appropriate in terms of how much these areas affected water quality on the basis of surface runoff. Grids rated "good" contribute the least amount to nutrient flows and would accept development with little consequence. Grids rated "poor" have the opposite affect. The grid classifications emanating from the nutrient flow model affect density levels as follows:

Base Line Density	Nutrient Flow Rating	Adjusted Density
High Density	Good	Density Bonus added onto high density
	Fair	Stays at high density
	Poor	Reduced to medium density
Medium Density	Good	Stays at medium density
	Fair	Stays at medium density
	Poor	Reduced to low density
Low Density	Good, Fair, Poor	Stays at low density

Considering Significant Resource Value. The significant resources determined to be most important to achieving the preservation goals were: upland patch diversity; connectivity between upland patches; non-cropped open fields; farmsteads; attractive areas; and land adjacent to open water. These areas were identified by combining all of the significant resources into one composite value to determine where clusters of resources were located. The spatial distribution of these composite significant resource values is presented in **Map 17.** The composite significant resource values were then used to raise or lower the adjusted density level of each grid cell. Values ranging from 0 to 50 were assigned to each of the constituent components of composite resource value, as follows:

Upland Patch Evaluation

30 pts. assigned to cells with most diversity and cells with a single cover type (top and bottom 10% of species diversity index

0 pts. assigned to cells with middle range diversity

Connectivity

50 pts. assigned to cells with a habitat connection rated 3
30 pts. assigned to cells with a habitat connection rated 2
20 pts. assigned to cells with a habitat connection rated 1

Non-cropped fields

40 pts. awarded to cells with a non-cropped field
0 pts. awarded to cells without a non-cropped field

Farmsteads

30 pts awarded to high rating for preservation
20 pts. awarded to medium rating for preservation
10 pts. awarded to low rating for preservation

Attractive areas: (based on available results of Park Board survey)

20 pts. awarded to cells that appeared 10 or more times on survey map
15 pts. awarded to cells that appeared 5-9 times on survey map
10 pts. awarded to cells that appeared 1-5 times on survey map
0 pts. awarded to cells that did not appear on survey map

Adjacent to water = 50 pts.

50 pts. awarded to cells adjacent to water
0 pts. awarded to cells not adjacent to water

Determining the Effect of Composite Resource Values on Density Level. Based on the composite resource values assigned to each 40 acre grid cell, the density of each 40 acre grid cell was adjusted as follows:

Existing Density Level	Composite Resource Value	Adjusted Density
High	100 and above	reduced to low density
	50-99	reduced to medium density
	11-49	stays at high density
	10 or less	density bonus added to high density
Medium	100 and above	reduced to low density
	50-99	stays at medium density
	0-49	stays at medium density
Low	0 and above	stays at low density

Those cells with high density and a density bonus represent areas that can build more intensively. Owners of these parcels could subdivide to two acre lots as opposed to 2-1/2 acre lots. To exercise this option, the owner would purchase development rights from owners of property that had been downzoned

from the original base line density levels.

Adapting Land Management Policies to Further Strengthen Preservation Goals. Team III felt it important that the Township consider adopting the following land management policies:

1. Provide tax incentives and/or technical assistance to insure maintenance on non-cropped open field in their existing state.

2. Acquire at least 200 feet of shoreline and an access to undeveloped land adjacent to the water.

3. Prohibit new development within 200' of shorelines to open water.

4. Enforce minimal mowing within 50 feet of open water, maintain existing vegetation within this 50 feet strip. Encourage enhancement of sufficient cover through technical assistance.

Establishing the Open Space System. With the location of high density areas already established, Team III identified appropriate sites for dedicated open spaces which could accommodate active recreation. Site selection criteria included: land within cells having limited development suitability; land having a central location or a location adjacent to existing park land; and land having a location which would facilitate connection to other neighborhoods or undeveloped lands. These criteria were used to identify areas which were accessible to both the neighborhood and a future connecting trail system.

Team III proposes a trail system through Linwood Township. To establish this system, the team examined several factors that would connect existing and proposed high density residential areas with the undeveloped lands preserved by the Team III planning process and existing park facilities. The trail system is designed to provide opportunities for all Township residents to enjoy preserved land. Trails are proposed through land that has not been subdivided, particularly through parcels owned by institutions. This criteria assumes that acquisition of easements would be the means to create the system. Presumably negotiations would be easier with fewer owners involved and with owners such as the Camp Fire Girls who would be amenable to such an agreement.

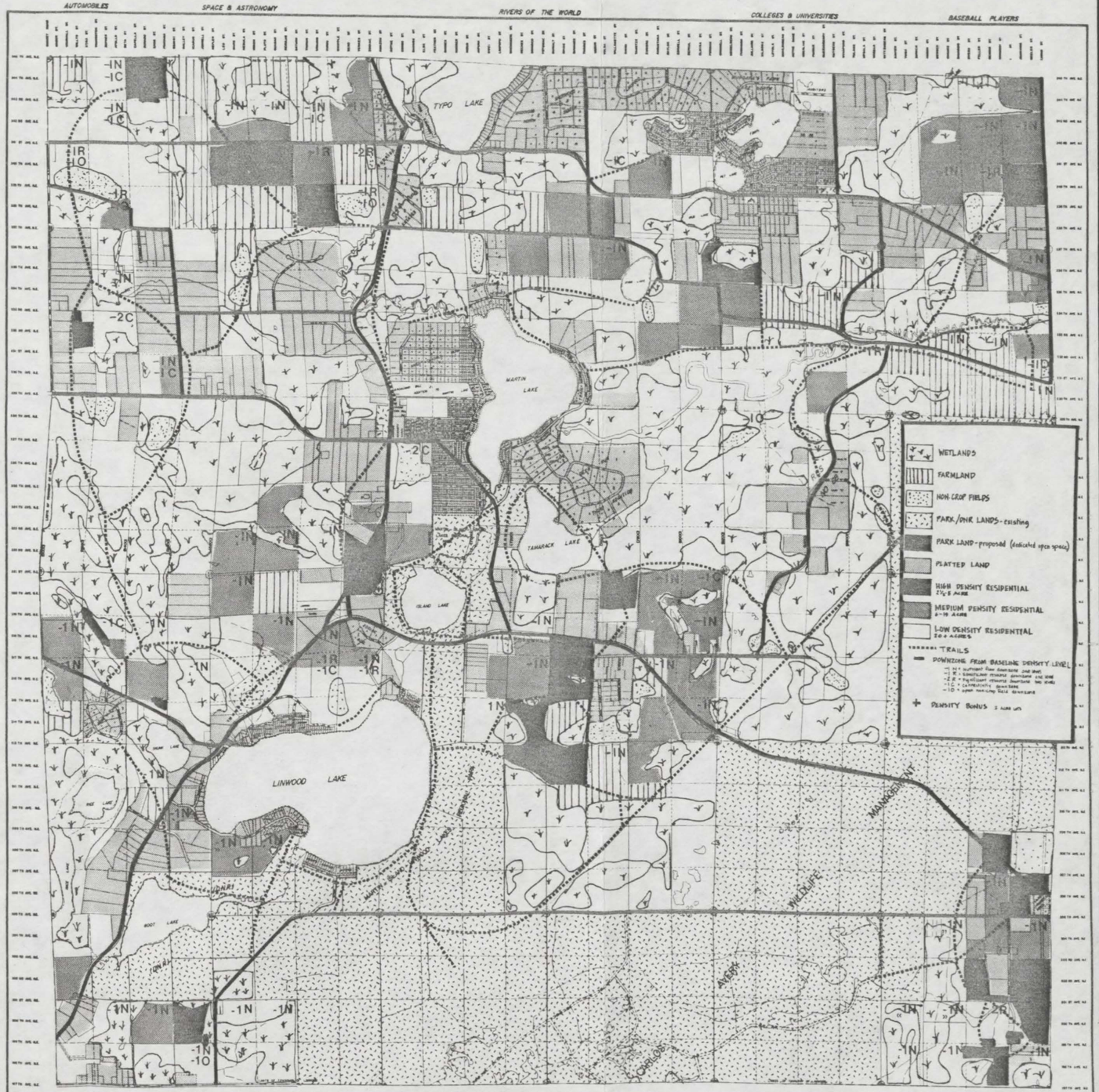
Summary

The end result of the Team III planning effort is presented in Figure 4 and **Map 18.** By creating a system of high and medium density zones interspersed with low density areas, Team III has preserved the diverse character of Linwood's landscape. The view from the road would show a series of open wetlands or farmlands within which small neighborhoods are settled. For the view off the road, the trail system allows an intimate, interior view of Linwood to be shared by all of the residents.

Team III believes that it has also maintained a level of services and density level which would not significantly increase the tax burden on Township

residents. This goal was achieved by maintaining a high percentage of low density areas as a means to preserve habitat and water quality goals instead of expensive acquisition.

The downzoning costs to the tax base have the potential to be recouped by transferring foregone development opportunities to density bonus areas. The resulting clustering saves infrastructure costs that would occur if undirected development occurs. Team III recommends continuation of the existing open space dedication programs to acquire intensive use areas in upland areas that are easy to develop for this purpose. Implementation of the trail system depends on easement acquisition, a less expensive alternative to fee simple purchase.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WILDLIFE
MANAGEMENT
AVERY
CORRIDOR
WETLANDS
FARMLAND
NON-CROP FIELDS
PARK/OPEN LANDS - existing
PARK LAND - proposed (dedicated open space)
PLATTED LAND
HIGH DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
TRAILS
DOWNZONE FROM BASELINE DENSITY LEVEL
DENSITY BONUS
N
PRESERVATION ALTERNATIVE
FINAL PLAN
TOWNSHIP OF LINWOOD
Team One, Preservation Alternative: Regina Bonsignore, Martha Smart

FIGURE 4.

V. Conclusions

None of the three future land use and open space development plans, by themselves, constitutes the plan to guide development of the Linwood Township landscape. Rather, they represent a series of ideas that the Township's Park and Recreation Commission and Planning Commission might consider as they plan for the future of the Township.

The range of results presented in Figures 1, 3, and 4, respectively, illustrates the variability of conditions that the Township might experience under varying development pressure and planning scenarios. The Design Team I proposal presented in Figure 2 guides future development primarily on the basis of soil suitability. The proposals of Team II, as presented in Figure 3, illustrate a more careful integration of data from the National Flood Insurance Program 100-year floodplain analysis. Finally, the proposals of Team III, (see Figure 4) present a more comprehensive investigation of land use potential based on intrinsic soil suitabilities, floodplain data and significant resource values.

Regardless of the course of planning action the Township decides to pursue, the landscape resource analyses described in Section III and presented in Maps 1 through 7 should prove valuable to future land use planning efforts. These data represent careful assessments of intrinsic development suitabilities of the Linwood landscape, flood hazards that exist in the Township, and significant cultural and resource values evident in the landscape. Potential uses of these data include not only defining future residential development and open space patterns. They might also be used in siting new Township facilities (e.g. a new park or Town Hall) as well as the siting of proposed regional facilities (e.g. a new airport).

The students of LA 5107 - Regional Planning and Design enjoyed the opportunity to pursue a "real-life" case study. Students more excited by the diversity of the Linwood landscape, and they were impressed with the Township's resolve to accommodate future development pressures in a manner that is with in the Township's fiscal capacities. Students were also pleased to find a Township Park and Recreation Commission that is sensitive to preserving and enhancing the Township's ecological structure and function. Through careful examination of the factors outlined in this report, and through careful integration of theses criteria into the land use planning and management process, the class felt that Linwood could achieve its goal of an orderly development pattern that also meets the open space needs of Township residents.